Exercise 2 – Exposure and Risk Assessment

Objective:

The aim of this exercise is to calculate the levels of exposure for a parent and a child (1-2 years old) over a weekend (2 days) based on different exposure scenarios. Students will use the ConsExpo tool (http://consexpoweb.nl) to calculate the exposure levels through inhalation, dermal contact, and oral contact. After calculating the exposure, students will evaluate if the levels of exposure in each scenario are of concern and discuss the associated risks.

Instructions:

1. Scenario 1: Inhalation Exposure from TV Casing
    - Details: Additives selected by your group are incorporated into a TV casing made from PP (Polypropylene). The TV is in an apartment where a family spends the weekend.
    - Assumptions:
        - TV surface area: 1 m^2
        - Thickness: 2 mm
        - Density of PP: 0.9 g/cm^3
        - Exposure via inhalation only, 24 hours/day (steady-state air concentration).
    - Task: Using ConsExpo, calculate the exposure level via inhalation for both the parents and the child (1–2 years-old). Ensure that you account for the correct air concentration and duration of exposure. **NOTE: set "start exposure" to 24 hour**—after 24 hour to allow the model to reach a steady state.
2. Scenario 2: Inhalation and Dermal Exposure from Household Plastics
    - Details: The family has several other household plastics (total surface area: 2.2 m^2) made from recycled PP, which contains contamination of the selected additives.
    - Assumptions:
        - Total surface area of plastics: 2.2 m^2
        - Thickness of plastics: 2 mm
        - Density of PP: 0.9 g/cm^3
        - Exposure via inhalation: 24 hours/day.
        - Exposure via dermal contact: 30 minutes/day, 20 cm^2 contact area.
    - Task: Using ConsExpo, calculate both the inhalation and dermal exposure levels for the parents and the child. For dermal exposure, consider the contact duration and contact area based on the chemical properties of the additives (assuming 100% absorption).
3. Scenario 3: Oral Exposure from Toy (Child Only)

- Details: The child has a piece of toy made from recycled PP containing contamination of the selected additives. The toy has been in use for a short period.
- Assumptions:
  - Toy weight: 10 g
  - Toy contact area: 10 cm^2
  - Exposure via oral contact: 3 minutes/day.
- Task: Using ConsExpo, calculate the oral exposure for the child. Consider the amount of additive that could be transferred to the child's mouth based on the surface area of the toy and the contact duration.

4. Exposure Calculations:
   - For each of the scenarios above, use the relevant parameters in ConsExpo to calculate the exposure levels for both the parents and the child. Make sure to adjust for any specifics, such as body weight differences between the child and parent. Be careful with the units!
5. Risk Assessment and Discussion:

   Once you have the exposure values, evaluate the results in relation to the potential health risks. Use the following criteria to guide your discussion:
   - Is the exposure level high enough to be of concern? Compare the calculated exposure to known safe exposure levels, such as reference doses (RfD) for the additives.
   - Do certain scenarios pose a higher risk than others? For example, is the child at a higher risk than the parent based on exposure routes like oral contact?
   - (Qualitative discussion, optional) What are the potential long-term risks? Consider cumulative exposure and the potential for bioaccumulation of the additive over time.

Input parameters: Be careful with UNITS!!

1. **Substance-specific parameters:**

   Please use the following template to collect data as input parameters for ConsExpo

	Chemicals of your choice
CAS Number	
Molecular weight [g/mol]	
Octanol-water partition coefficient (log Kow)	
Product/air partition coefficient (log)	Using the equation in https://doi.org/10.1039/C5EM00664C
Mass transfer coefficient [m/hour]	10 (a common assumption)
Diffusion coefficient [cm^2/hour]*	https://www.stevenabbott.co.uk/practical-solubility/diff-d-values.php
Initial migration rate [µg/(cm^2*min)]	Using equation (5) in https://doi.org/10.1038/s41370-021-00354-0

Reference dose [mg/(kg bw*day)]	

*** Note:** For the inhalation model, due to the tool setting, it is not possible to give a value less than 3.6E-8. So please use 3.6E-8 in the inhalation model if your estimated value is lower. For the dermal model, please use your estimated value.

2. Exposure-specific parameters

Inhalation	Exposure model: Emission from solid materials; Room volume: 250 m^3; Ventilation rate: 0.6 per hour; Inhalation rate (36 m^3/day for adults, 10.1 m^3/day for 1-2 years-old children)
Dermal	Exposure model: Direct contact – Diffusion
Oral	Exposure model: Direct Product Contact – Product Mouthing

3. Scenario-specific parameters

Scenario 1	Weight fraction substance: using the maximum value in https://doi.org/10.1021/acs.estlett.4c00355, SI2, use values from the "max_ppm" column across the available data to determine the maximum
Scenario 2	Weight fraction substance: 0.05% (EU limits for the cumulative sum of PBDEs)
Scenario 3	Weight fraction substance: 0.05%